U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-253 362

PROCEDURES FOR THE IDENTIFICATION AND ASSESSMENT OF COMMUNITY ODOR PROBLEMS

COPLEY INTERNATIONAL CORPORATION

PREPARED FOR
ENVIRONMENTAL PROTECTION AGENCY

OCTOBER 1971

161113

PB 253 362

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Prepared for the

ENVIRONMENTAL PROTECTION AGENCY
Under Contract No. CPA 70-116

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October 1971

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

ACKNOWLEDGMENTS

Copley International Corporation gratefully acknowledges the cooperation of many private citizens who gave generously of their time by participating in personal interviews. Without their wholehearted cooperation, this manual would not have been possible. Copley International Corporation is especially grateful to Mr. Richard C. Dickerson of the Environmental Protection Agency for his counsel and assistance in the development of this document.

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IDENTIFICATION AND ASSESSMENT OF COMMUNITY ODOR PROBLEMS

INTRODUCTION

The procedures described in this manual are designed to assist governmental agencies in dealings with community odor problems caused, particularly, by industrial operations. The procedures are addressed to "local" agencies since the investigation of community odor problems usually occurs within the public health departments or air quality offices of local government. They are, however, equally applicable to the needs of state agencies operating at the local level.

BACKGROUND INFORMATION

The contents of this manual were developed primarily from the results of two studies — the national survey of the odor problem, conducted in 1969, and a study of the social and economic impact of odors, conducted in 1970 and 1971. Both were conducted by Copley International Corporation for the Environmental Protection Agency. Secondarily, the contents evolved from the findings of other research done in the United States and Sweden, and from the opinions of scientists, jurists, and many local agency officials. The procedures represent a logical sequence of investigation from problem identification and source verification to a promise of uncomplicated methods of social and economic assessment.

The difficulty with the investigation of community odor problems lies in the lack of objective evidence that such problems exist. Analytical equipment is available to measure low concentrations of a few odorous substances, but even in situations involving such substances, there is no way to translate known concentrations into odor intensities. Equally distressing, there is no way to translate known odor intensities into an index of problem perception. Thus, for the present at least, reliance must be placed on personal evaluation by the normal or ordinary person in the community.

Traditional methods for solving community odor problems include the presentation of subjective evidence to the courts for consideration under public nuisance law, which, for remedy, requires substantial and unreasonable interference to the normal person in the community. The most widely used form of such evidence has been complaints initiated by residents. On the surface, it would seem that such evidence must define the existence of a problem. Yet, under a literal interpretation of public nuisance law, it may not. It is seldom determined from complaints whether the complainants, individually or as a group, actually represent the ordinary person or whether the ordinary person has suffered interference.

The procedures described in this manual are offered for use in connection with public nuisance law in lieu of counting complaints or attempting to extract meaningful information from complainants' remarks. Within these procedures, complaints are relegated to a proper function of alerting local authorities to the locations of possible odor problems.

Problem Identification Based on Public Attitude Surveys

The most direct means of identifying community odor problems is an attitude survey. This stems from the personal nature of odor evaluation and the concept that attitudes reflect personal evaluations. Unlike odor complaints, an attitude survey of a randomly selected sample of residents would satisfy public nuisance law. The random sample would represent the normal person. Attitudes expressing annoyance (typical in odor cases) would represent interference.

To determine whether interference is substantial and unreasonable creates a complexity. Equity is involved. It is unfair to find substantial and unreasonable interference on the basis of an arbitrary percentage of residents who express annoyance. Recent studies* have found that, even in virtually odor free areas, up to 50 percent of the residents may express annoyance to odors. This is due to a variety of factors including, for example, residents with unusual sensitivity to background odors, feelings against nearby industry, and neurosis.

The procedure for problem identification provides an equitable basis for showing the extent of interference suffered. It is assumed that the percentage of residents who would express annoyance to odors when odors are not present is approximately equal in all communities of similar socio-economic characteristics in a particular metropolitan area. (Once established for communities of similar socio-economic characteristics, the percentages must not be applied to communities of other characteristics in the same metropolitan area or to communities of similar characteristics in other metropolitan areas. This assumption is supported by the results of the study of the social and economic impact of odors.) It is also assumed that residents of all communities have equal right to odor free air. By comparing the results of identical attitude surveys conducted in a suspected odor problem community and a similar, but odor free community, it can be statistically determined if a greater percentage of residents in the former area express annoyance. If so, an odor problem is identified and an equitable basis for showing substantial and unreasonable interference is provided.

Source Verification Based on Sensory Techniques

Whenever an odor problem has been identified, the source of the odors must be found if the problem is to be remedied. When odors are experienced in a community frequently or over long duration, it is common for the residents to know or at least suspect the source. Still, the source must be verified by local authorities.

* Reference ?

The unaided nose of a trained observer is adequate in most investigations. However, if the unaided nose is not sufficient at times when odors are apparent, the use of sensory techniques must be considered. The procedure for source verification describes two of the most successful techniques — one featuring speed of measurement, the other, depth.

The use of sensory techniques in problem identification may be possible in the future. This alternative to the use of public attitude surveys may save time (including the time of residents who would otherwise be interviewed) and expense without much loss of confidence in the results. What is needed to examine this possibility is concurrent use of the sensory techniques and public attitude surveys recommended by this manual on numerous occasions over time.

Based on the outcome of field tests performed by its developers, the scentometer is recommended for indicating the locations of possible odor problems during routine surveillance. A condition for its use in this capacity is given in a following paragraph.

Problem Assessment

By problem assessment is meant a determination of economic and social impact of odors on a community. Such information would support, but not replace the need for problem identification in odor cases. Tentative methods of problem assessment have been developed, the most comprehensive of which are documented in the final report of the social and economic impact study. However, because they are not yet refined to the level of problem identification and source verification and because they require highly specialized social science skills not possessed by most local agencies, they are not included in this manual.

CONDITIONS WARRANTING USE OF THE PROCEDURES

Two types of odor situations may exist in a community. One may lead to an odor problem; the other does not. They are referred to as acute episodes and chronic situations and are distinguished under public nuisance law, which is not concerned with occasional causation of odors. For purposes of the following definitions, causation of odors is meant to infer continued emission of odorous substances into the atmosphere, not merely a result of impaired atmospheric dilution capacity.

Acute Episodes

An acute episode is defined as a causation of odors beyond the property limits of a source, occurring no more than once and lasting no more than one day in any three month period. An acute episode involving the emission of measurable concentrations of odorous substances into the atmosphere should be dealt

with as a possible infraction of the air quality standards governing such substances. An acute episode should not be considered as a possible odor problem regardless of the characteristics of the odors caused.

Chronic Situations

A chronic situation is defined as a causation of odors beyond the property limits of a source occurring more than once or lasting more than one day in any three month period. A chronic situation involving the emission of measurable concentrations of odorous substances should be dealt with as a possible infraction of the air quality standards governing such substances. A chronic situation should be considered as a possible odor problem under any of the following conditions:

(1) If one or more odor complaints are initiated by residents of a community and verified by local authorities after the first day of the first occurrence in any three month period.

(2) If twenty or more odor complaints are initiated by residents of a community, but not verified by local authorities after the first day of the first occurrence in any three month period.

(3) If odors are detected during routine surveillance by local authorities when traveling through a community nearby the source. Such odors must be of sufficient intensity to be detected using a Barnebey-Cheney Model I-3 Scentometer set at 7 dilutions to threshold.

PROCEDURE FOR PROBLEM IDENTIFICATION BASED ON BRIEF PUBLIC ATTITUDE SURVEYS

INTRODUCTION

The following procedure is designed to allow local agencies to conduct, with their own personnel, public attitude surveys to identify community odor problems. If sufficient funds are available to the local agency, a professional interviewing or survey firm could be engaged to perform many of the tasks described in this procedure. However, the additional expense is not necessary if the procedure outlined is followed with care by local agency personnel. It is important to note that failure to adhere to the procedure could lead to survey results that are misleading or meaningless.

Before describing the detailed steps to be undertaken in conducting a public attitude survey, it may be helpful to summarize the major tasks to be completed. These tasks are described in general terms below.

This survey is designed to compare the attitudes of people residing in a community thought to be an odor problem area with attitudes of similar people residing in an odor free area. Attitudes of both groups are determined by conducting interviews by telephone with residents of both areas. (Tasks followed by an asterisk (*) could be done by an interviewing firm.)

(1) The first task is to define the possible odor problem area.

(2) Next, a matching odor free area is located.

(3) Utilizing a street address (reverse order) telephone directory, a list of telephone numbers in each area is made, and a sample of these telephone numbers is selected at random.*

(4) Utilizing the questionnaire provided in this procedure, telephone interviews are conducted with the man or lady of the house for each telephone number included in the sample.*

(5) The total number of responses to key questions asked in both areas is then tabulated and compared for problem identification.

(6) Finally, if an odor problem is found, an odor problem index number is calculated.

WHEN TO USE PUBLIC ATTITUDE SURVEYS

A public attitude survey should be conducted only after any of the three conditions stated in the previous section of this procedure indicate the location of a possible odor problem.

SETTING UP TEST AND CONTROL AREAS

The community in which an odor problem is suspected is called the "test area." The first task to be undertaken is to define the preliminary geographic limits of the test area. This can be done by driving an automobile in a grid pattern throughout the general area, while noting the geographical boundaries within which the odor is perceived. Meteorological data indicating wind patterns can also be helpful in setting these boundaries, as can complaint patterns. It is necessary to establish a test area that has boundaries coincident with those of census tracts. If only a portion of a census tract is included in the preliminary boundaries of the test area, that census tract should not be used unless a large proportion of the entire census tract is probably affected by odors. It is important to include only those tracts where an odor problem is likely; otherwise, the results of the survey may not be conclusive.

Next, the socio-economic characteristics of the test area must be determined. Using the latest U. S. Census of Population and Housing Census Tract Reports (PHC), list the following characteristics of the test area: median income for families, median value of owner-occupied housing units, median gross rent of renter-occupied units, median number of rooms, and year structure was built.

An odor free community must now be located that matches the test area as closely as possible. This community is called the "control area." The following criteria should be used in choosing the control area.

(1) The control area should be as odor free as possible.

(2) The control area should be located within ten miles of the test area.

(3) The control area should have the same type of access to freeways or turnpikes as the test area.

(4) The control area should be located within approximately the same distance from commercial or industrial establishments as the test area.

(5) The median income, home value, gross rent, and age of structure (the latter must be figured from year structure was built) for the control area should not differ from that of the test area by more than 20 percent.

(6) Median rooms (per house) should not differ by more than 10 percent for any one category. For example, suppose the test area contains 646 housing units having five rooms out of a total of 2,332 housing units; then, 27.7% are in the five room category. Suppose the control area contains 375 units having five rooms out of 1,981 units; then, 18.9% of the units are in the five room category. For this example, the difference is 8.8% (27.7% - 18.9% = 8.8%), which is acceptable.

OBTAINING A SAMPLE

First, list all the streets in the census tract(s) that have been selected for the test area. Note the house number of the first and last house within the census tract(s) on each street that runs beyond the test area. Using a street address (reverse order) telephone directory, which can be obtained from the telephone company, count the total number of telephones that are listed for streets in the test area. In this count, do not include professional offices, commercial establishments, government offices, or industrial facilities. Next, using a table of random numbers, select one number that falls between the number "1" and the total number of telephones in the test area. Count from the first test area address in the directory to this number. This is the starting point, i.e., the first telephone number to be used for the sample. Refer to Table I to determine the number of telephone numbers to be passed over before a second telephone number is chosen (the sampling interval). Write down this address and telephone number. Continue in this manner until all telephone numbers in the test area have been written down or passed over as part of the sampling interval. It should be noted that if the starting point is toward the middle of the alphabetically listed streets in the directory, when the last street in the test area is reached, the sampling should be continued by returning to the first alphabetically listed street in the test area.

When this procedure has been completed for the test area, the same thing should be done for the control area.

Table I. Sampling interval.

Number of Telephones in the Area	Sampling Interval
1 - 90	include all telephones
91 - 180	2
181 - 270	3
271 - 360	4
361 - 450	5
451 - 540	6
541 - 630	7
631 - 720	8
721 - 810	9
811 - 900	10
901 - 990	11
911 - 1080	12
1081 - 1170	13
1171 - 1260	14
1261 - 1350	15
1351 and over	16

CONDUCTING THE SURVEY

Each time interviews are conducted in the test area, they must also be conducted in a matching control area. This is necessary to permit the statistical comparisons required to verify the findings of the survey. Surveys should be conducted concurrently in the test and control areas. The same control area may be used for different test areas if the residents have the same socio-economic characteristics as those in a second test area.

Telephone calls to administer the questionnaire should not be made before 9:00 a.m. nor after 9:00 p.m. To reduce the elapsed time needed to complete the telephone calls, the samples may be divided among two or more interviewers. If only two interviewers are used, one may be assigned to call the control area sample while the other calls the test area sample. To reduce the possibility of interviewers biasing the results of the survey, it is desirable to switch the interviewers about half way through the sample, i.e., after one-half of the telephone calls in the test area have been made by one interviewer, this person should make calls in the control area. The other interviewer will make the balance of the test area calls. A blank copy of the questionnaire will be needed for each telephone number to be called.

Pretesting the Survey

Because it is unlikely that local agency personnel are experienced in conducting telephone surveys, it will be of considerable help to pretest the survey.

However, the pretest results should not be combined with those of the actual survey.

Arrange for the persons who will conduct the telephone interviews to read the "Instructions for Interviewers" section of this procedure. When this has been done, have each interviewer go through the questionnaire asking the questions aloud of another agency employee. Note whether the interviewer is following instructions in every detail, and correct any errors in interviewing technique. Then, select at random five telephone numbers for each interviewer who will participate in the survey. These telephone numbers should be different from those chosen as part of either the test or control area samples. Have each interviewer call five numbers and administer the questionnaire. Again, note whether the interviewer is following instructions, and correct any errors. When each interviewer is thoroughly familiar with the questionnaire and interviewing technique, begin calling the telephone numbers in the test and control area samples.

Instructions for Interviewers

Because people would usually like to tell you what they believe you want to hear, it is important that the interviewer restrict what is said to the questions or comments on the questionnaire. If the interviewer engages in pleasantries or chats with the person answering the questions, the responses received may be different from those that would otherwise be obtained. The interviewer should be particularly careful not to indicate by either comment or tone of voice any reaction to the answers received. It is also important for the interviewer not to reveal the name of the agency conducting the survey nor the reason the survey is being conducted. Some respondents may challenge the interviewer or question the validity of the survey. Such situations must be handled with a great deal of tact on the part of the interviewer. The respondent has the right to determine whether the survey is legitimate, but if information about the agency or the survey is given before the questions are asked, the respondent's answers may not be valid. Therefore, if possible, the interviewer should agree to tell the respondent this information after the questionnaire is completed. If the respondent refuses to continue the interview without this information, the interview should be terminated.

The respondent may suspect that the call is being made in connection with the sale of a product. The interviewer may assure the respondent that this is not the case prior to asking the questions. It may also be necessary to tell the respondent that the answers given will become a part of a statistical summary and individual responses will not be revealed in any way. If required, this may also be done prior to asking the questions.

Never suggest an answer or train of thought to the respondent. Do not prompt in any way. The most important job of an interviewer is to encourage

the respondent to express his or her attitudes freely and to be specific in conveying these attitudes. Close attention to the clarity and completeness of the responses is important. Never talk up or down to a respondent. Do not comment on the meaning of any question or indicate in any way what kind of answers are expected.

If the respondent asks a question or fails to understand or respond to a question, read the question over again more slowly, using a pleasant but neutral tone of voice. On occasion, it may be necessary to repeat a question more than once before obtaining a response. Do not allow any tone of impatience to creep into your voice.

When asking the questions, stress only those words that are underlined. Do not change the wording of any question. These questions have been carefully constructed to obtain the information desired. Do not change the order of the questions from that listed on the questionnaire.

Before making a telephone call, the interviewer should fill out the upper portion of the questionnaire (a copy of the questionnaire is included at the end of this procedure). From the sample listing, fill in the telephone number, street address, and city to which the call will be made. The "File No." blank is provided for identification of the odor source under investigation. This blank should not be filled in until the source has been verified. The "Survey No." blank is provided to allow differentiation between test and control area responses, as well as surveys conducted at a later time. For example, before the first survey of a suspected odor problem, "Survey No. 1" could be assigned to the test area and "Survey No. 2" could be assigned to the control area. If the same areas are the subject of another survey at a later date, survey numbers 3 and 4 could be assigned.

The "Respondent No." should be left blank until tabulation of the survey results is begun. However, the date of the call and the time of day the call is made should be noted on the questionnaire before the call is made.

Interviewer Instructions for Making Calls

Call the telephone number filled in on the questionnaire. If there is no answer or the line is busy, go on to the next telephone number on the list.

If the call is answered, read the opening statement, saying your name in the appropriate place. If the person who answers the telephone is obviously a woman, use the feminine alternatives in the statement; if a man, the masculine alternatives. Children, relatives, or friends living in or visiting the household should not be interviewed. In addition, no person under 18 years of age should be interviewed. Make sure that the person with whom you are speaking is the man or lady of the house. If he or she is not, try to talk with the man or

lady of the house. If this cannot be done, terminate the call, check that the interview was not completed, note the reason, and go on to the next telephone number in the sample.

If the man or lady of the house refuses to be interviewed at all, note that the interview was not completed and the reason. "Refused" is a sufficient explanation.

The numbered blanks in the right-hand margin of the questionnaire are to be used in tabulating the responses. Do not write in these spaces at this time. Every question has a list of responses after it. Except for question 3, only one answer should be checked. If the respondent gives more than one answer for a question, ask which answer is the best answer to the question. When a question is followed by three periods, such as, "How strong would you say these odors smell? Would you say...?", read the answers provided in the order they are listed, but do not read either the answer numbers or the response "Don't know."

When a question is not followed by three periods, such as, "When was the last time you noticed odors in your neighborhood?", do not read the responses. In this case, simply check the answer that corresponds to the respondent's reply. When a question has a space provided for "Other answers," write down everything the respondent says. If local agency secretaries are used as interviewers, they should use only longhand to write down "Other answers."

Interview Instructions for Specific Questions

The following instructions should be adhered to in asking the specific questions on the questionnaire.

Question 1. Do not read the responses. If the respondent answers "No," read the statement following the "No" response and terminate the interview.

Question 2. Do not read the responses. If the respondent answers "Yes," ask question 3. If the respondent answers "No" or "Don't know," ask question 4.

Question 3. This question should be asked only of those people who answered "Yes" to question 2. Read the responses, except for "Don't know." Check all answers that the respondent gives to this question.

Question 4. Do not read the responses. If the respondent answers "No," or "Don't know," skip to question 12. If the respondent answers "Yes," ask question 5.

Question 5. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 6. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 7. Read the responses rather slowly, pausing between each possible response. Do not read "Don't know." Repeat the question and responses, if necessary, to obtain a reply.

Question 8. Do not read the responses. Check the response that covers a period most like that identified by the respondent. Repeat the question, if necessary, to obtain a response, but do not read the possible responses.

Question 9. Do not read the responses. If the respondent answers "No" or "Don't know," skip to question 11. If the respondent answers "Yes," ask question 10.

Question 10. Read the responses rather slowly, pausing between each possible response. Do not read "Don't know." Repeat the question and responses, if necessary, to obtain a reply.

Question 11. Do not read the responses. Clarify the response, if necessary, by asking the respondent to explain more fully what is meant by the answer given. For example, if the respondent says "Some factory," clarification might elicit the answer, "An oil refinery near my neighborhood." Write down other source(s) identified by the respondent.

Next, read the statement preceding question 12 regarding the confidential nature of the information being gathered.

Question 12. Do not read the responses. Clarify the responses, if necessary, as explained under question 11. Write down the other company mentioned by the respondent if the answer is not the source(s) under investigation.

Question 13. Do not read the responses. Clarify the response, if necessary, as explained under question 11. Write down the other companies or employers mentioned if the answer does not include the source(s) under investigation.

Interviewer Instructions for Completing Interviews

Read the statement at the end of the questionnaire and terminate the interview. Write your name in the space provided, and check the space for a completed interview on the first page of the questionnaire. Go on to the next telephone number.

Interviewing should be continued until all of the telephone numbers in the sample have been dialed once. Review the completed questionnaires, and remove

those where the answer to either question 12 or question 13 indicates a member of the household is employed by the odor source under investigation. This is necessary because of the potential bias of the respondent either in favor of or against the employer. If the source has not been verified by an agency inspector, this step should be ignored.

Next, count the number of completed questionnaires remaining for the test area. If there are at least 30, the interviewing portion of the survey is complete. If not, continue to interview, utilizing those telephone numbers where no-answers or busy signals were received, until at least 30 questionnaires are completed or until all no-answers or busy signals in the sample have been called a second time. Do the same thing for the control area.

Tabulation

If the local agency has access to electronic data processing equipment, and the number of responses in either the test or control area exceeds 90, consult with those in charge of such equipment to set up procedures for tabulating the survey. If such equipment is not available or the number of responses in each area is small, hand tabulating is quite satisfactory.

Regardless of the tabulating procedure utilized, the completed questionnaires must be edited and coded. Editing should be done by persons other than those who conducted the interviews. The purpose of this task is to insure that all questions have been asked and answers recorded. Inconsistencies also can be identified and corrected.

On each questionnaire there should be a response to all appropriate questions. For example, if question 2 concerning people in the neighborhood complaining about pollution has been answered with a "Yes," then question 3 dealing with the kind of pollution people complain about should have also been answered, even if the answer is "Don't know."

The following comments regarding each question on the questionnaire may be used as a guide for editing. If editing uncovers errors or omissions, it may be necessary to call the respondent back to clarify an answer which has been incorrectly recorded or to eliminate an inconsistency.

Question 1. If the response is "No," all other questions on the questionnaire should be unanswered.

Question 2. If the response is "Yes," there should be an answer to question 3. If the response is "No," there should be no response to question 3.

Question 3. There should be no response to this question if question 2 has a "No" reply.

Question 4. If the response is "No" or "Don't know," questions 5, 6, 7, 8, 9, 10, and 11 should not contain responses. If the answer to question 4 is "Yes," questions 5, 6, 7, 8, 9, and 11 must have been answered, also, even if the answer is "Don't know."

Question 5. There should be a reply to this question only if question 4 was answered "Yes." If so, there must be a reply to this question.

Question 6. Same as question 5.

Question 7. Same as question 5.

Question 8. Same as question 5.

Question 9. Same as question 5.

Question 10. If the response to question 9 was "No" or "Don't know," there should be no response to this question. If the response to both question 4 and question 9 was "Yes," this question should have been answered, also.

Question 11. Same as question 5.

Question 12. There should be a response to this question on all questionnaires except those where the response to question 1 was "No."

Question 13. Same as question 12.

When the editing is completed, the questionnaires should be coded. This merely means writing the number of the response to each question on the appropriate line near the right-hand margin of the questionnaire. If there was more than one response to question 3, the number of each type of pollution mentioned may be written in the margin.

When the coding is completed, each questionnaire should be numbered on the first page in the blank following "Respondent No." The same sequence of numbers may be used for the test area and the control area, since the areas would be distinguished by the survey numbers assigned earlier.

Tabulation may be accomplished in one of two ways. A form can be designed on which to tally the number of responses of each kind to each question. (A recommended form is provided at the end of this procedure.) An alternative is to sort the questionnaires themselves into stacks according to the answers to a particular question and count the number of questionnaires in each stack. This method tends to be somewhat more error free than tallying.

Regardless of the method used, the total of all responses to each ques-

tion (except question 3) must match the total number of people asked that question. This provides a check on the accuracy of the tabulation. (Since question 3 is a multiple response question, the total number of all responses may exceed the total number of people asked that question. Questionnaires containing more than one response to question 3 should be separated from those having only one response. Tabulate and total the responses on questionnaires having only one response. Then, tabulate separately the responses for each kind of pollution mentioned on the questionnaires with more than one response. Finally, add the two tabulations together to obtain the total number of responses for each kind of pollution included in question 3.)

For purposes of odor problem identification, it is not necessary to tabulate the responses to all questions. Question 1 is included in the survey to avoid errors caused by the use of street address telephone directories that may be as much as six months old. (Such directories are published at six-month intervals.) Questions 2 and 3 are included for introductory purposes. Questions 4 through 10 provide odor problem definition. Question 11 permits possible identification of the odor source. Questions 12 and 13 are included so that employees of the source under investigation may be removed from the sample.

All questions may be tabulated and will yield useful information, but for odor problem identification, tabulation should begin with question 9. The responses to question 9 alone will indicate whether an odor problem exists. If it is determined that an odor problem does not exist, complete tabulation of all questions need not be undertaken.

PROBLEM IDENTIFICATION

The decisive step in odor problem identification is to determine whether a significant difference exists between the proportion of respondents in the test area who are bothered by odors and the proportion of respondents in the control area who are bothered by odors. This is done by using the tabulated results of question 9 from the test area and control area surveys. A form entitled "Odor Problem Identification" is included at the end of this procedure to provide a convenient method for determining whether a significant difference exists. A technical explanation of the method is presented in the "Statistical Reference" section of this procedure.

If, after completing the "Odor Problem Identification" form, the number in the box labeled "z" is equal to or larger than 1.29, a significant difference exists between the test and control areas. If "z" is less than 1.29, no significant difference exists. If this analysis indicates no significant difference, then it should be concluded that the test area is not an odor problem area. If a significant difference is indicated, then an odor problem index number should be calculated to indicate the extent of the odor problem relative to other odor

problems identified within the jurisdiction of the local agency. The odor problem index number may be simply constructed by completing a form entitled "Determination of the Odor Problem Index." This form is also included below. It is based on a formula given in the "Statistical Reference" section.

OTHER USES OF SURVEY RESULTS

During abatement proceedings, it may be necessary to refer to the results of the test area survey to indicate the percentage of test area residents who responded in a particular way. For example, it may be necessary to state the percentage of all test area residents who noticed odors in their neighborhood during the week of the survey. It would be inaccurate, however, to use directly the percentage of test area residents who answered "This week" to question 8. An adjustment is required to eliminate responses to question 8 that are actually based on variables other than odors.

The adjustment is easy to accomplish. Simply subtract the percentage response to the question in the control area from the percentage response in the test area. The answer is then divided by one hundred percent minus the percentage response in the control area. The resulting percentage is the true percentage response for the test area. Thus, if 65% of test area residents and 25% of control area residents stated they noticed odors in their neighborhoods "This week," then 53% would represent the true percentage of test area residents who actually noticed odors in their neighborhood during the week of the survey (65% - 25%/(100% - 25%) = 53%).

PUBLIC ATTITUDE SURVEY OF COMMUNITY ODOR PROBLEMS
PROBLEM IDENTIFICATION QUESTIONNAIRE

Respondent:

Phone No. _____ File No. _____

Street Address _____ Survey No. _____

City _____ Respondent No. _____

Record of Call:

Date	Time	Check If Interview Completed	Check If Interview Not Completed	Reason If Not Completed
_____	_____	( )	( )	_____

"Hello. My name is _____(name)_____. I'm calling (long distance) for a government agency interested in certain community problems. I'd like to talk with the man/lady of the house to get his/her opinion on a few questions. Are you the man/lady of the house?" (IF NOT, ASK: "May I talk with him/her?")

Q1) Have you lived at your present address more than six months?

___1. Yes

___2. No (SAY: "I'm sorry. This survey was designed for longer term residents. Thank you for your time.")

1_____

Q2) Lately, people have become very much concerned about the environment and various types of pollution. Do people complain about any kind of pollution in your neighborhood?

___1. Yes (ASK Q3.)

___2. No (ASK Q4.)

___3. Don't know (ASK Q4.)

2_____

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Q3) Do people complain about...?

___1. Air pollution in your neighborhood

___2. Water pollution in your neighborhood

___3. Airport, industrial, or traffic noise in your neighborhood 3_____

___4. Noticeable odors in your neighborhood

___5. Don't know (DO NOT READ THIS RESPONSE.)

Q4) Have you noticed any odors in your neighborhood in the last three months?

___1. Yes (ASK Q5.)

___2. No (SKIP TO Q12.) 4_____

___3. Don't know (SKIP TO Q12.)

Q5) How often have you noticed these odors?

___1. At least once a day

___2. At least once a week, but not every day

___3. At least once a month, but not every week 5_____

___4. Less than once a month

___5. Don't know

Q6) Generally speaking, how long do these odors last?

___1. At least one day

___2. At least one hour, but less than one day

___3. At least 15 minutes, but less than one hour 6_____

___4. Less than 15 minutes

___5. Don't know

Q7) How strong would you say these odors smell? Would you say...?

___1. Very strong

___2. Strong

___3. Moderate 7_____

___4. Slight

___5. Don't know (DO NOT READ THIS RESPONSE.)

Q8) When was the last time you noticed odors in your neighborhood?

___1. This week

___2. Last week

___3. Two to four weeks ago/a month ago 8_____

___4. More than a month ago

___5. Don't know

Q9) Would you say that these odors have bothered you?

___1. Yes (ASK Q10.)

___2. No (SKIP TO Q11.) 9_____

___3. Don't know (SKIP TO Q11.)

Q10) How much would you say they have bothered you? Would you say...?

___1. Very much

___2. Much

___3. Moderately 10_____

___4. Little

___5. Don't know (DO NOT READ THIS RESPONSE.)

Q11) Where would you say most of these odors originate, that is, who or what causes them?

___1. Source(s) being investigated

___2. Other source(s): _____

_____ 11_____

___3. Don't know

"All this information is strictly confidential, but we need it for statistical purposes."

Q12) What company do you work for?

___1. Source(s) being investigated

___2. Other company/none: _____

_____ 12_____

___3. Refused

Q13) What companies do other members of your household work for?

___1. Source(s) being investigated

___2. Other company(ies)/none: _____

_____ 13_____

___3. Refused

"That completes the interview. Thank you very much for your time."

Interviewer's Name: _____

PUBLIC ATTITUDE SURVEY - TABULATION FORM

File No. _____
Survey No. _____

Instructions. Place a tally mark in the appropriate box to record the answer to each completed question on the questionnaire. By tallying the fifth duplicate response with a diagonal line, counting total responses is simplified (𝍸 = 5 responses).

Question 1. (Tabulate only if desired)		
Response 1	Response 2	
Total Response 1	Total Response 2	Total

Question 2. (Tabulate only if desired)			
Response 1	Response 2	Response 3	
Total Response 1	Total Response 2	Total Response 3	Total

Question 3. (Tally all responses given on each questionnaire, if desired)					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 4.			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

Question 5.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

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PUBLIC ATTITUDE SURVEY - TABULATION FORM (Continued)

File No. _____
Survey No. _____

Question 6.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 7.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 8.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 9.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

Question 10.					
R 1	R 2	R 3	R 4	R 5	
Total R 1	Total R 2	Total R 3	Total R 4	Total R 5	Total

PUBLIC ATTITUDE SURVEY - TABULATION FORM (Continued)

File No. _____
Survey No. _____

Question 11. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

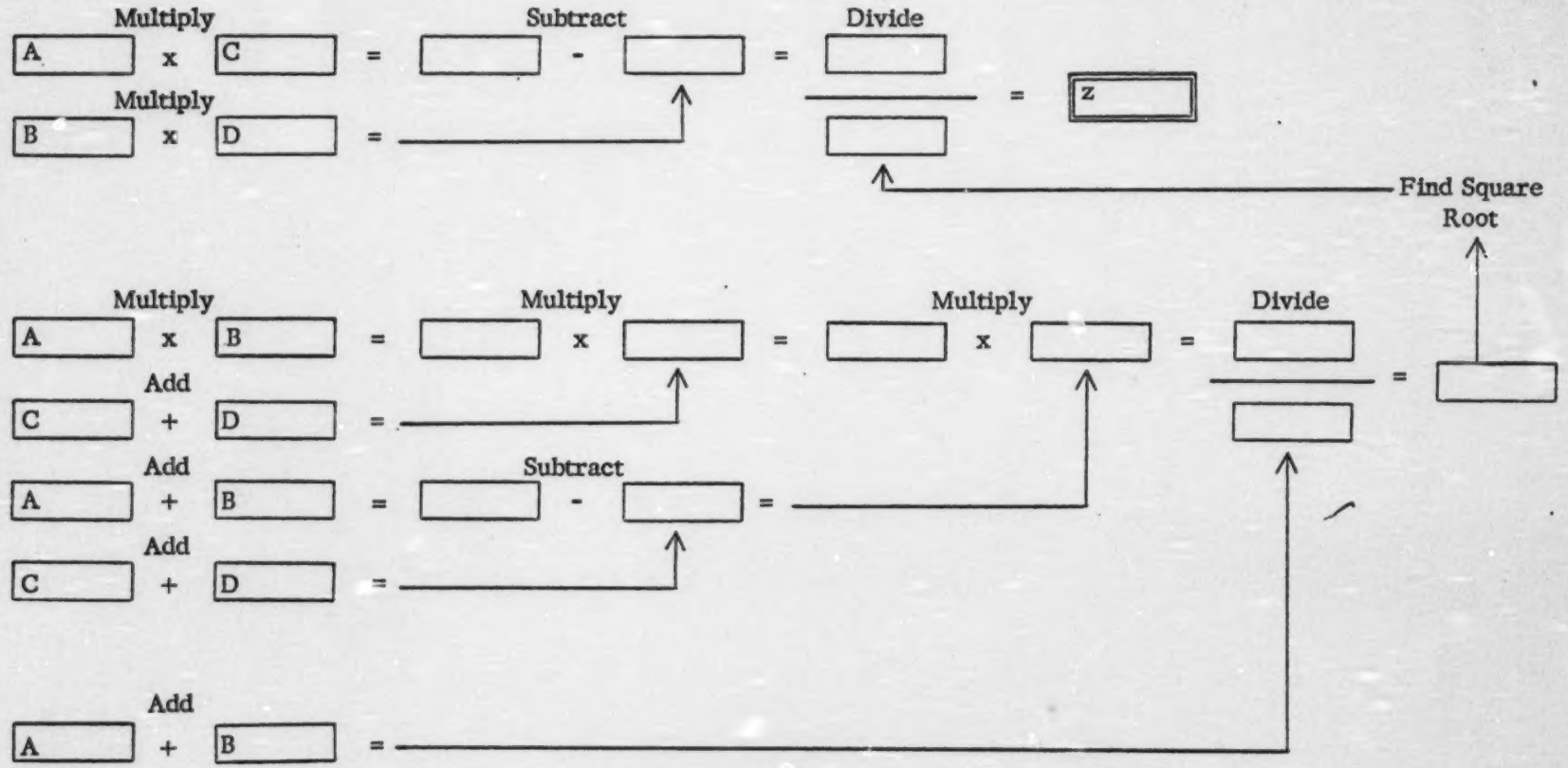
Question 12. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

Question 13. (Tabulate only if desired)			
R 1	R 2	R 3	
Total R 1	Total R 2	Total R 3	Total

ODOR PROBLEM IDENTIFICATION

Instructions

1. In each box labeled "A," fill in the total number of responses to Question 9 from the Control Area survey. (Total number of responses = number of "Yes" responses (R 1) + number of "No" responses (R 2) + number of "Don't know" responses (R 3).)
2. In each box labeled "B," fill in the total number of responses to Question 9 from the Test Area survey.
3. In each box labeled "C," fill in the number of "Yes" responses (R 1) to Question 9 from the Test Area survey.
4. In each box labeled "D," fill in the number of "Yes" responses (R 1) to Question 9 from the Control Area survey.
5. Follow the direction of the arrows. Perform the calculations indicated. (The square root can be easily found by referring to a standard table of square roots and, therefore, need not be calculated.)
6. If the number in the box labeled "z" is 1.29 or more, an odor problem exists.

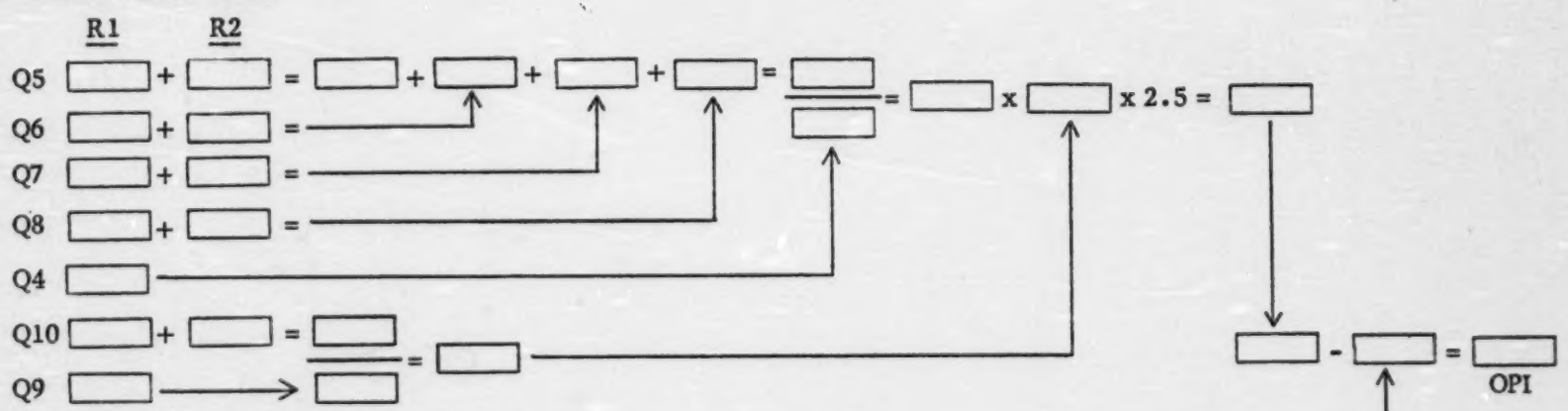


DETERMINATION OF THE ODOR PROBLEM INDEX

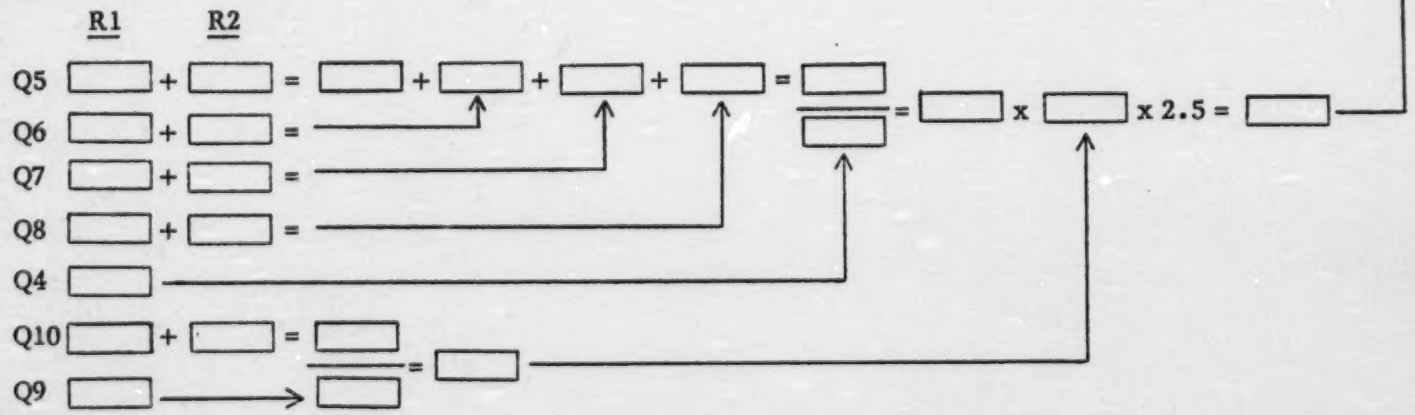
Instructions

Insert the total numbers of responses tabulated from the surveys in the boxes provided. Follow the direction of the arrows. Perform the calculations indicated. Round all decimal numbers to the nearest tenth.

Test Area Responses



Control Area Responses



STATISTICAL REFERENCE SECTION

Statistically Significant Differences for Odor Problem Identification

To determine whether there is a significant difference between the test and control area responses to question 9 of the Problem Identification Questionnaire, the following hypotheses must be tested:

Hypothesis 1 (H_1): $\pi_t = \pi_c$

Hypothesis 2 (H_2): $\pi_t > \pi_c$ (one tail test)

$\alpha = 0.10$

where: π_t = the true or universe proportion of "Yes" responses to question 9 in the test area

π_c = the true or universe proportion of "Yes" responses to question 9 in the control area

α = the probability of concluding, on the basis of sample values, that no significant difference exists between test and control areas when a significant difference in universe values exists

Using the normal approximation:

$$(1) \quad z = \frac{(p_t - p_c) - (\pi_t - \pi_c)}{\sqrt{\frac{\pi_t(1 - \pi_t)}{n_t} + \frac{\pi_c(1 - \pi_c)}{n_c}}}$$

where: n_t = the sample size, i.e., the total responses to question 9, in the test area

n_c = the sample size, i.e., the total responses to question 9, in the control area

k_t = the number of "Yes" responses to question 9 in the test area

k_c = the number of "Yes" responses to question 9 in the control area

$$p_t = \frac{k_t}{n_t}$$

$$p_c = \frac{k_c}{n_c}$$

Assuming the null hypothesis is true, this equation becomes:

$$(2) \quad z = \frac{p_t - p_c}{\sqrt{\hat{\pi}(1 - \hat{\pi})(\frac{1}{n_t} + \frac{1}{n_c})}}$$

Estimating π by $\hat{\pi} = \frac{k_t + k_c}{n_t + n_c}$

and setting $N = n_t + n_c$

and $K = k_t + k_c$

then (2) can be rewritten as:

$$z = \frac{\frac{k_t}{n_t} - \frac{k_c}{n_c}}{\sqrt{\frac{K(N - K)}{N n_t n_c}}} = \frac{n_c k_t - n_t k_c}{\sqrt{\frac{n_t n_c K(N - K)}{N}}}$$

If z is normal, then the probability of $z \geq 1.29 = 9.85\%$ or approximately 10%.

Determination of the Odor Problem Index

$$OPI = 2.5 \left[\frac{(R1+R2)_{Q5} + (R1+R2)_{Q6} + (R1+R2)_{Q7} + (R1+R2)_{Q8}}{(R1)_{Q4}} \cdot \frac{(R1+R2)_{Q10}}{(R1)_{Q9}} \right] \text{ Test Area}$$

$$- 2.5 \left[\frac{(R1+R2)_{Q5} + (R1+R2)_{Q6} + (R1+R2)_{Q7} + (R1+R2)_{Q8}}{(R1)_{Q4}} \cdot \frac{(R1+R2)_{Q10}}{(R1)_{Q9}} \right] \text{ Control Area}$$

where: OPI = Odor Problem Index

R1 = response 1; R2 = response 2; etc.

Q1 = question 1; Q2 = question 2; etc.

The above formula is based on the Problem Identification Questionnaire. Assuming that the control area is as odor free as possible (at least as free of odors as the test area), the formula will yield an index number between zero and 10. The size of this number depends upon the combination of frequency (Q5), duration (Q6), intensity (Q7), and recentness (Q8) of odors noticed in the test area as compared to the control area. This combination of problem-inducing variables is weighted by the extent to which odors have caused bother in each area.

Adjustment to Eliminate Test Area Responses Based on Variables Other Than Odors

The formula is a Bayesian type of correction for chance success:

$$P'(S|s) = \frac{P(S|s) - P(S|n)}{1 - P(S|n)}$$

where: $P'(S|s)$ = the percentage of "signal" attributable to the variable under study

$P(S|s)$ = the total percentage of "noise" plus "signal" measured in the test group

$P(S|n)$ = the percentage of "noise" measured in the control group

PROCEDURE FOR SOURCE VERIFICATION BASED ON SENSORY TECHNIQUES

INTRODUCTION

This procedure is designed to assist local agencies in source verification of identified odor problems. It describes the proper use of two sensory techniques, one using a Barnebey-Cheney Model I-3 Scentometer, the other employing an odor judgment panel trained to evaluate an odorized environment in terms of memorized reference standards. As implied below, the choice of techniques for use in a particular case depends upon the extent of information desired.

An odor judgment panel can be used not only to verify the source and areal extent of odors, but also to judge odor intensities concurrently at points throughout a test area. The size of an odor panel depends on the size of the test area and the transiency of the odors encountered. In general, the larger the test area or the more transient the odors, the larger must be the odor panel. In most cases, one panelist per city block would provide adequate coverage.

A scentometer can be used to cover as much area as twelve panelists (about six square city blocks), but for somewhat different purposes. Scentometer measurements would yield much less information than twelve panelists for the same period of time. Additional scentometers must be used to cover a large test area or to obtain more information about the same area.

WHEN TO USE THE SCENTOMETER

The scentometer is best suited for use in routine surveillance of chronic situations. It should be used to determine if odors can be detected above a specified dilution to threshold and, thereby, to indicate the locations of possible odor problems.

The scentometer could be used to assist a trained observer to verify the source of an identified odor problem if such verification cannot be established by the observer's unaided nose. Specifically, it could be used:

(1) To establish a pattern of peak odor intensities, which may point to the source, while systematically traversing the test area in an automobile.

(2) To function as an odor free air chamber, and so, to refresh the trained observer whose ability to continuously sense the odor under investigation may otherwise be lessesed due to fatigue.

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It is noted, however, that although the scentometer is always ready for immediate use in routine surveillance, it is not always applicable to source verification. This is because of the difficulty of obtaining readings if odors are transient or just discernible to the unaided nose.

WHEN TO USE AN ODOR JUDGMENT PANEL

An odor judgment panel should be used to verify the source of an identified odor problem if such verification cannot be established by a trained observer alone or by a trained observer using a scentometer. For source verification, an odor judgment panel can be used:

(1) To establish patterns of mean odor intensities and percentages of time odor was detected from concurrent evaluations at points throughout the test area.

(2) To judge the odor under investigation when odors of different qualities are encountered in the test area.

Such uses are possible only after lengthy selection and training processes necessary to ensure that the panelists can accurately relate to a series of reference standards.

THE SCENTOMETER

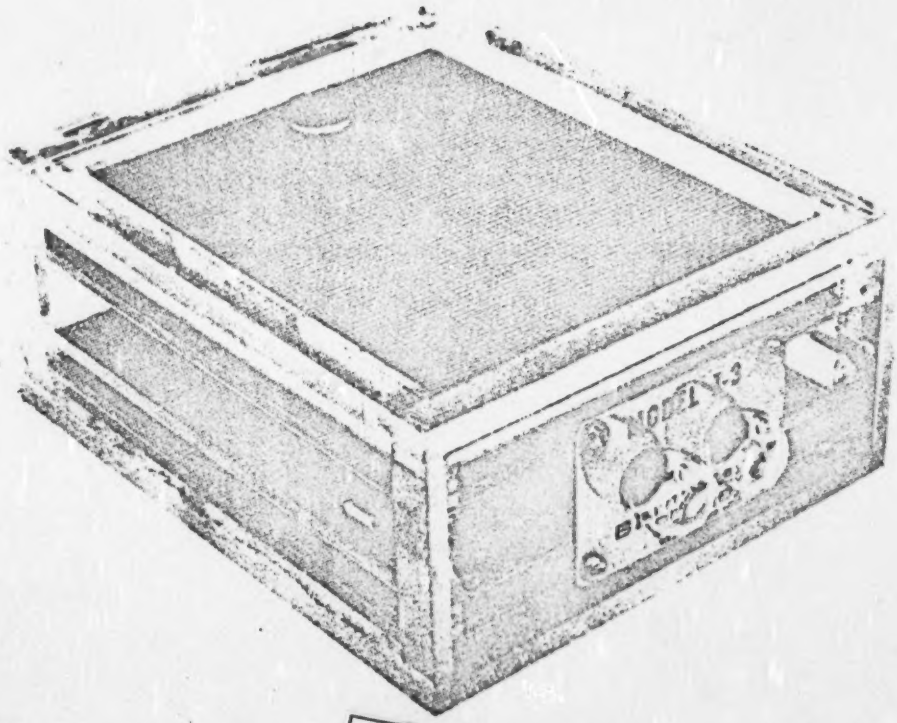
The scentometer (Figure 1) has been described by its developers and used by at least twelve local air quality agencies throughout the United States. Most of the descriptions have focused on the physical characteristics of the device and the principles of operation. Emphasis in this procedure is based on experience gained from actual use.

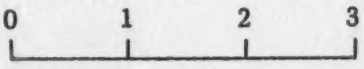
Preparation for Field Use

Before going into the field, the scentometer should be checked for proper function as follows: Tapes must be placed over the four dilution orifices in such a way that they can be pulled clear of the orifices and replaced repeatedly. It should be determined that all odors are absorbed by the charcoal beds. If necessary, fresh charcoal should be installed. Before each use, the scentometer should be shaken gently in a horizontal position to distribute the charcoal evenly over the beds, thereby eliminating the possibility of channeling.

The scentometer must be examined for leakage, especially around the two bulbs which fit to the operator's nostrils. If the bulbs are applied with pressure to the nostrils to avoid leakage, soreness can develop during constant

Figure 1. Barnebey-Cheney, Model I-3 Scentometer.





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use in the field. If the bulbs are placed gently against the nostrils, leakage can result. Before and during measurements, the operator should check that no leakage of any type is occurring. This is done by using the scentometer in an area of strong odor after blocking the four orifices. No odor should be discernible.

Field Measurements

Before field measurements are attempted, the scentometer operator must first neutralize the effects of ambient odors by inhaling odorless air through the charcoal beds of the scentometer, while keeping the four orifices blocked. When this is accomplished, he should open the orifices of the scentometer in turn, until he can identify the smallest orifice through which odor can be detected.

It is noted that, while this technique is generally successful with strong and constant odors, very few readings may be obtained with low intensity and transient odors. Under the latter conditions, it is advantageous to use the scentometer while driving through a community. The application of this technique by a mobile operator is fairly simply and considerably more effective.

If odors are encountered in a community during routine surveillance, the intensities should be measured with the scentometer. Intensities detected at a particular dilution to threshold would indicate the location of a possible odor problem. After traversing the community several times, the operator should relax and breathe odor free air. This can be done by using the scentometer as an odor free chamber. However, it is more desirable to drive outside the test area, since it is difficult for the operator to relax with the scentometer bulbs pressed against the nostrils.

When the operator is suitably refreshed, the car is again driven through the affected area. Throughout this drive the operator breathes through the scentometer with a selected orifice open. The route then may be retraced with a different orifice uncovered, in order to further define the odor intensity. Each time the route is traversed, the operator calls out the points at which negative readings change to positive and vice versa. These points should be plotted on a map of the area or recorded on a form such as the "Scentometer Log Sheet" provided at the end of this procedure. It is possible to have four operators and a driver traverse the area in one car. With a different orifice open on each scentometer, a reading for any odor in the area can be quickly obtained.

This method, while more effective than scentometer readings taken at a fixed point, entails some problems. The automobile must be well ventilated and maneuverable. There must be two to five people in each car. If there are less than five people in a car, the success of the technique depends upon the con-

stancy of the odor, since two or more trips through the area would be required to obtain readings through all of the orifices.

THE ODOR JUDGMENT PANEL

If a local agency wishes to perform odor judgment panel evaluations, panel members could be recruited from among the agency employees. This approach could reduce the urgency of preliminary activities and lower costs considerably, since panelist selection and training could be conducted at leisure at the agency facilities. It must be considered, however, that the results of evaluations by agency employees could be criticized as being biased against the source under investigation.

Regardless of this possibility, certain preliminary activities must be undertaken each time an odor judgment panel is to be used. These activities include determination of the size of the panel required, location of suitable stations (points in the test area at which panelists would be placed), location of a panel headquarters (if the agency facilities cannot be used), and preparation for transporting the panelists between the headquarters and the test area.

Preliminary Activities

The community in which an odor judgment panel is to be used should be visited to determine the areal extent of the odors to be investigated. It should be initially planned to provide one panelist for each city block affected by odors. If the test area is very large, the size of the panel must be determined by budgetary constraints. It is recommended that a minimum of twelve panelists be used for source verification in any case where public nuisance law is applicable.

The stations should be located in a systematic manner so that panel members are roughly equally spaced, with intervening distances not exceeding one city block (approximately 100 yards). Local odor interferences such as caused by automotive service garages, bakeries, or heavily traveled roadways should be avoided when selecting stations. Large scale maps of the test area should be used to plot all stations. Such maps should be sketched if none are available from commercial or governmental sources.

In addition to selecting stations, convenient locations for performing panel calibration tests must be found. These locations must be immediately downwind from an odor source, at places where the presence of large panel groups will not cause much disturbance in the neighborhood. Public parking lots, particularly for municipal golf courses and parks, work well.

The headquarters, which is the site used for testing, screening, training, and assembling, should be located close to the test area. The shorter the

distance between these locations, the less the expense and proportion of daily schedule consumed in travel. However, one problem with having a headquarters close to the site is the possibility of leakage of information to the source under investigation. Depending upon secrecy requirements, it may be necessary to locate several miles distance from the site. Once in the test area, the presence of an odor panel is quickly noticed not only by residents, but possibly by employees of the facilities under investigation. Therefore, if secrecy is important, it may be desirable to use the panel for single days only, or for two or more randomly chosen days.

Transportation of the panelists to the test area can be by either cars or a bus. If a bus is used, all panelists may be transported together, and only one local agency representative is required to serve as driver. However, a significant amount of maneuvering is required in this work, and buses are not readily maneuverable. Cars are more maneuverable but, as the entire panel cannot be transported in one car, additional drivers are required. Cars are preferable as long as the area is known and several drivers are available, while a bus is preferable to a convoy of cars in a strange area.

To ensure proper selection, training, and deployment of panelists, one agency representative should be assigned to work with a maximum of six panelists. If such representatives would serve as drivers, the requirement for additional drivers is easily satisfied. Nine passenger station wagons provide an ideal compromise between buses and cars. With vehicles of this capacity, six panelists and their assigned agency representative can be transported together.

Recruiting Potential Panelists

If sufficient agency employees are not available for this work, it may be necessary to engage a professional survey firm to recruit panel members. It is preferable to select panel members with similar socio-economic characteristics to the residents of the test area, as although the panelists are asked only to relate the odor to standard intensities, bias may be introduced if panelists have a different background. If a panel is required for one week or less, college students and temporarily unemployed males are available, but if a panel is needed for longer periods or from time to time at regular intervals, housewives are usually the most available group.

Initial Selection of Panelists

After sufficient candidates have been recruited, the screening of potential panelists should be undertaken. Such screening is intended to exclude individuals with particularly insensitive or irrational responses to odors. Series of triangle tests are used initially to screen potential panelists. This method is quick, easy, and inexpensive to perform. The necessary equipment

consists of a supply of 2-ounce paper cups, water, and odorous food extracts such as vanilla and wintergreen. The prospective panel members are given three cups to sniff and are instructed to specify the cup with the different odor. The three cups presented to the panelists may be one of the three following combinations:

(1) Two with the same odor, one with a different odor.
(2) Two with water (no odor), one with an odor.
(3) Two with the same odor, one with water (no odor).

It is best to begin this test using strongly scented samples detectable to everyone. The concentration of extract should be gradually decreased in water toward threshold levels. If the tests are conducted over several hours, breaks should be taken at regular intervals to avoid sensory fatigue. The test room should be well ventilated and odor free. Using an activated carbon room purifier unit, such as the Barnebey-Cheney Model ABB (4,000 cfm) or Model ADB (10,000 cfm), may be necessary to ensure an absence of ambient odor.

After six to nine tests involving all panelists, the scores should be reviewed to ascertain the percentage of correct answers. A range of correct answers should be chosen as a target, say 50% to 75%. If, for most prospective panelists, the actual percentage is outside this range, the concentration of odorants must be readjusted. Finally, potential panelists are accepted or rejected on the basis of their scores. An acceptance range of plus and minus two correct answers from the mean of the group is recommended.

Final Selection of Panelists

After the preliminary screening by triangle testing, training with reference standards is begun. A non-toxic, stable standard should be chosen that closely matches the odor to be encountered in the test area. Using various concentrations of this standard, the remaining candidates (now called "panelists") are trained to recognize the strengths of the odor with which they will be concerned. Any one of a variety of standards may be utilized. In a study of solvent emissions, for example, a methyl chloroform series may be used for degreasing process odors, a turpentine series for thinner odors, or an amyl acetate series for lacquer solvent odors. A panel recruited to observe rendering plant odors can be trained with ethanolamines. For refinery odors, reference standard solutions of tertiary dodecyl mercaptan are suitable.

The reference standard is dissolved in varying concentrations in an odorless solvent and numbered according to strengths. The number of strengths in a series may vary from 4 to 12, depending upon the range of odor intensities expected to be encountered and the ability of the trained nose to differentiate between the strengths of adjacent solutions. As exemplified in Table II, if the number of

strengths in a series is limited to four, each solution might be four times more concentrated than the previous solution.

Table II. Concentration of reference standard in odorless solvent used to simulate four strengths of the odor expected to be encountered in the test area.

Odor Intensity Rating	Concentration in Solvent (milliliters/liter)	Layman Assessment
1	0.125	slight
2	0.5	moderate
3	2	strong
4	8	very strong

The reference standards should be mixed ahead of time, although the undiluted odorant and solvent should be brought to the panel headquarters in case different or additional concentrations must be prepared.

Again, the test room should be well ventilated and odor free. The standards may be presented in 4-ounce polyethylene bottles with a polyethylene seal insert to minimize the possibility of leakage caused by shaking. Even with these bottles, however, napkins or paper towels should be kept on hand in case of spills.

Panelists should be instructed to shake the bottle gently once or twice, remove the cap, and squeeze the sides once as they hold the bottle under the nose. After a period of memorizing the different strengths and a few breaks to avoid fatigue, they should be encouraged to test themselves by removing a standard from the series at random and attempting to judge its intensity. At this time, the panel instructors should circulate about the room and test the panelists with unmarked samples. Prior to the training, a few sets of standards will have been prepared on which the numbers are not clearly shown but are hidden on labels on the bottle bottoms. All panelists should be asked to sniff one of these samples and judge the strength of the odor. Candidates' scores should be recorded and combined with the results of field calibration tests (described below) before the panel selection is finalized.

Instructions to Panelists

When the results of the reference standard tests indicate that the panelists are ready to go into the field, briefing on recording procedure is necessary. In addition, the following points should be stressed to them:

(1) All evaluation materials, including clipboards, rating sheets, and pencils, will be supplied by the local agency.

(2) A watch with a second hand and a large, easily read face should be worn by each panelist.

(3) Appropriate clothing, including hats, coats, and gloves, should be worn by each panelists if unfavorable weather is to be expected. (The work involves standing on streets. Cold wind and dampness, which may be present, can affect the efficiency of the unprepared panelist.)

(4) Smoking by panelists (and, particularly, by local agency personnel) is forbidden.

(5) Perfume and other strongly scented toiletries should not be worn.

(6) Gum chewing and similar diversions by panelists are discouraged.

(7) The recognition of transient odors requires constant attention. Panelists should be as alert to the task as possible.

(8) Panelists must rate odors encountered in the test area in accordance with the strengths of the reference standards memorized in the test room.

All values should be recorded on an "Odor Intensity Rating Sheet," an example of which is included at the end of this procedure. How frequently values should be recorded depends upon the frequency, duration, constancy, and intensity of the odors. Panelists should be asked to record the highest intensity present during each minute. The time recorded should reflect the end of each minute. For example, "Time: 10:40 a.m., Intensity: 1" means that 1 was the highest level perceived between 10:39 a.m. and 10:40 a.m. Similarly, "Time: 3:45 p.m., Intensity: 0" means that no odor was detected between 3:44 p.m. and 3:45 p.m.

Determining the "quality" of the odor perceived is often a problem, i.e., whether or not an odor encounterd is that which bothers test area residents. Panelists should be instructed as follows:

(1) If the panelist is not sure whether the odor is from the source under study, he must record the odor intensity as well as possible and make a notation regarding odor quality.

(2) Only if the panelist is certain that the odor is foreign, i.e., if he can positively identify it as coming from some source

other than that under study) should he record a zero. Even in such a case, he should describe the quality of the odor perceived.

Calibration Tests

Uniformity of response among panelists must be monitored during both the training and field phases of the work. This is done by conducting field calibration tests, i.e., by having all panelists record data at one site. There should be a distance of at least two yards between panelists to ensure independent recordings. Any panelists who consistently records values significantly different from those of the majority should be rejected. Calibration tests actually serve two purposes. In addition to indicating the uniformity of the panelists' responses and, consequently, the reliability of the field values, they provide additional training and experience in the field.

Work Schedule

To get all panelists to work as a unit and, thereby, avoid those delays which result in reduced evaluation time in the test area, a rigid adherence to schedule is required. It has been observed that about one hour is the optimum time to leave a panelist on station. The panelist's concentration capabilities deteriorate significantly after working in solitude in one place for an hour. The type of schedule shown in Table III has been found to work well:

Table III. Recommended work schedule.

Time Period	Activity
9:30 a.m.- 9:50 a.m.	Arrival of panelists, ready for departure
9:50 a.m.-10:10 a.m.	Travel to site, position panelists at first stations
10:10 a.m.-11:20 a.m.	Panelists record at first stations
11:20 a.m.-11:40 a.m.	Transfer to second stations
11:40 a.m.-12:50 p.m.	Panelists record at second stations
12:50 p.m.- 1:10 p.m.	Return to headquarters
1:10 p.m.- 2:10 p.m.	Lunch, restroom, etc.
2:10 p.m.- 2:20 p.m.	Short discussion, ready for departure
2:20 p.m.- 2:40 p.m.	Travel to site, position panelists at first stations
2:40 p.m.- 3:50 p.m.	Panelists record at first stations
3:50 p.m.- 4:10 p.m.	Transfer to second stations
4:10 p.m.- 5:20 p.m.	Panelists record at second stations
5:20 p.m.- 5:40 p.m.	Return to headquarters
5:40 p.m.- 5:45 p.m.	Dismissal of panelists
Total time evaluating odors	4-3/4 hours
Total time working	7-1/4 hours
Total time on break	1 hour
Total time per day	8-1/4 hours

Panel calibration tests can be incorporated into the schedule by reducing the 1 hour and 10 minute periods allocated to panelists at individual stations. Normally, one 10 minute calibration test in the morning and another of equal duration in the afternoon is sufficient to monitor uniformity of response.

General Observations

Based on the results of the use of odor judgment panels during the national survey of the odor problem and the study of the social and economic impact of odors, some observations are offered for local agency consideration.

(1) In general, women seem more emotionally involved than men and, therefore, appear less detached and specific.

(2) Some panelists become very anxious during calibration runs, whereas they are relaxed when alone during actual field measurements.

(3) Some panelists have difficulty in concentrating if left alone for long periods, and start talking to passers-by, listening to radios, etc. Some discipline is required.

(4) Panelists should be instructed to try to avoid direct questions from passers-by and, if necessary, should indicate that they are surveying cars or other objects unrelated to odors. Some are able to be convincing without difficulty, while others may have trouble.

(5) Panelists are sometimes questioned by police. It is therefore necessary to inform the local police of the field schedule before the evaluations take place.

SOURCE VERIFICATION

The data recorded by individual panelists can be summarized by panelist and by station. (Based on the recommended work schedule, as many as four panelists per day could be assigned to the same station.) Since the relative ability of each panelist to the panel as a whole may be estimated by use of the calibration tests, the most appropriate summary is by stations.

Psychologists generally prefer the use of median values as a measure of central tendency of data generated by human evaluation. But, because of the typically skewed distribution of odor intensity ratings by odor judgment panelists (particularly when odors are transient, many "no odor" ratings are listed), the mean values recorded at each station are recommended for summary purposes.

A form entitled "Odor Intensity Rating Summary Sheet" is provided at the conclusion of this procedure for the convenience of local agency personnel in preparing summary information.

A summary of odor judgment panel data can be used to plot odor intensity isopleths for the test area investigated. Such isopleths may show mean odor intensities or the percentages of time that odor was detected. Examples of typical isopleths are shown in Figures 2 and 3. By plotting isopleths, studying recorded wind data for the periods of panel evaluation, and noting the topographical features of the test area, the odor source usually can be verified with confidence and a pattern of odor intensity levels throughout the test area can be established.

Figure 2. Example of isopleths representing mean odor intensities recorded by odor judgment panelists stationed in a test area at the points indicated.

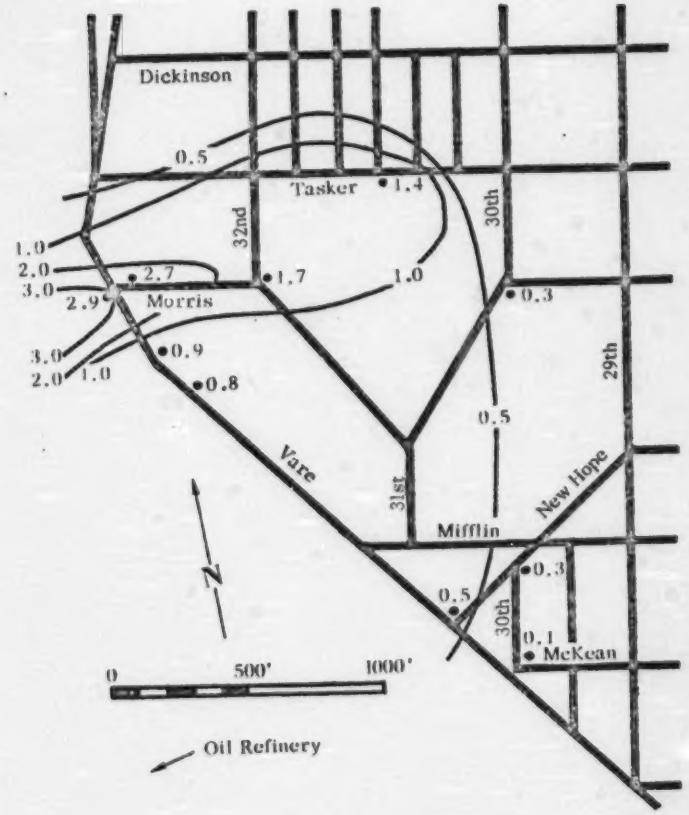
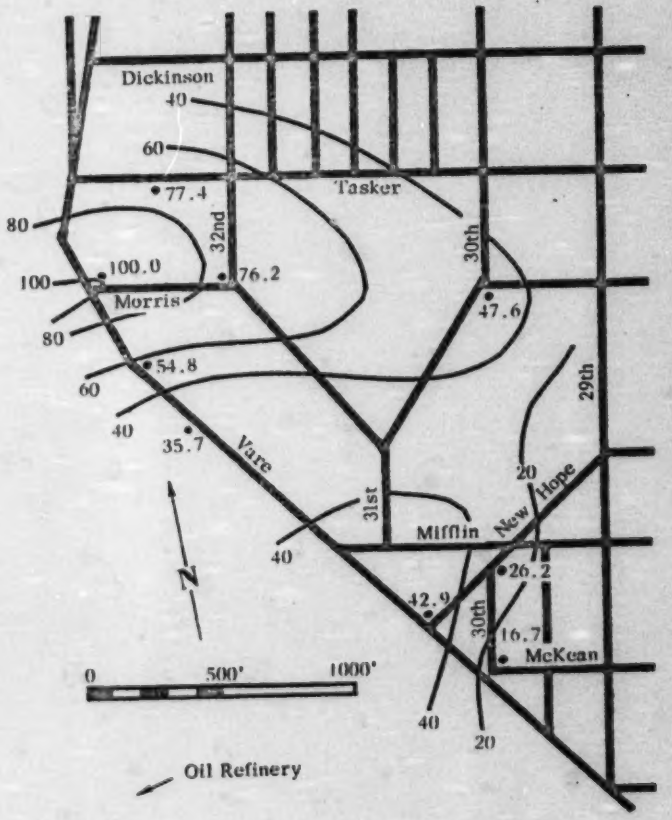


Figure 3. Example of isopleths representing percentages of time odor was detected by odor judgment panelists stationed in a test area at the points indicated.



File No. _____ SCENTOMETER LOG SHEET Date _____

Community(s) Affected _____ Odor Source(s) _____

Operator 1 _____ Operator 2 _____ Operator 3 _____ Operator 4 _____

Points at Which Readings Were Taken		Operator No. and D/T Setting							
		Opr: D/T:		Opr: D/T:		Opr: D/T:		Opr: D/T:	
		Time and Reading (+ or -)							
Street Traveled	Cross Street or Landmark	T	R	T	R	T	R	T	R

Points at Which Readings Were Taken		Operator No. and D/T Setting							
		Opr: D/T:		Opr: D/T:		Opr: D/T:		Opr: D/T:	
		Time and Reading (+ or -)							
Street Traveled	Cross Street or Landmark	T	R	T	R	T	R	T	R

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ODOR INTENSITY RATING SHEET

NAME _____ DATE _____

LOCATION _____ LOCATION _____

TIME	RATING	COMMENTS	TIME	RATING	COMMENTS

ODOR INTENSITY RATING SUMMARY SHEET

Panelist Location (Station)	Percent Time Detected and Mean Odor Intensity																			
	Date:				Date:				Date:				Date:				Date:			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M	%	M

PROCEDURE FOR PROBLEM ASSESSMENT

INTRODUCTION

Tentative methods of problem assessment are contained in the final report, "A Study of the Social and Economic Impact of Odors, Phase II." The principal economic effect of odors can be measured in terms of property value differentials, especially residential property value differentials. A description of the data required and analysis employed in this aspect of problem assessment is presented in chapter VI. An effects determination questionnaire was developed to determine how residents feel odors have affected themselves, their families, and their properties. Property values, living patterns, and health symptoms are covered. A description of the questionnaire and its use is included in chapter VII.

WHEN TO ATTEMPT PROBLEM ASSESSMENT

To most common effect of odors — annoyance — is readily measured using the procedure for problem identification. Based on results of the above mentioned study, economic and other social effects are measurable only in an extremely chronic situation. Such a situation may be assumed to exist if more than 50 percent of the test area residents interviewed, using the problem identification questionnaire, state they have been bothered "Very much" by odors in their community (question 9, response 1).

APPENDIX

ESTIMATES OF COSTS INCURRED FROM USING PROCEDURES

Estimates of the costs of services and materials necessary for problem identification and source verification are listed below by task and cost category. Where possible, these estimates are based on 1971 prices averaged for the United States as a whole. Consequently, they may differ somewhat from actual costs incurred in a particular metropolitan area.

Local agency labor requirements are listed in terms of mandays only. Daily rates must be applied by agency officials.

Public Attitude Survey Costs

The estimates given in this section represent the costs of conducting identical public attitude surveys in one test area and one control area.

Task/Category	Estimated Cost	
	Unit	Total
Task I: Select Test and Control Areas		
Supervisory time	1 manday/area	2 mandays
Clerical time	1 manday/area	2 mandays
Purchase of U. S. Census of Population and Housing Census Tract Reports (first survey only)	$5	$5
Purchase of census tract maps for agency's jurisdiction (first survey only; necessary only if maps are not included in U. S. Census of Population and Housing Census Tract Reports	$15	$15
Task II-A: Select Telephone Numbers for Samples		
Clerical time	1 manday/area	2 mandays
Rental of street address telephone directories (for usual six month period)	$50/directory/area	$100

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Task/Category	Estimated Cost	
	Unit	Total
Task II-B: Conduct Interviews		
Supervisory time (first survey only)	1 manday	1 manday
Clerical time:		
Training (first survey only)	2 mandays	2 mandays
Interviewing	2 mandays/area	4 mandays
Reproduction of questionnaires	120 questionnaires @ $0.20/questionnaire	$24
Telephone toll charges (if applicable)	60 calls/area @ $0.25/call	$30
Task II (Alternative): Select Sample and Conduct Interviews		
Reproduction of questionnaires	120 questionnaires @ $0.20/questionnaire	$24
Professional survey firm charges:		
Select sample	$50/sample/area	$100
Conduct interviews	60 interviews/area @ $3.50/interview	$420
Telephone toll charges (if applicable)	60 calls/area @ $0.25/call	$30
Task III: Edit Questionnaires		
Clerical time	0.5 manday/area	1 manday
Task IV: Code Questionnaires		
Clerical time	0.5 manday/area	1 manday
Task V: Tabulate Responses		
Clerical time	2 mandays/area	4 mandays
Reproduction of tabulation forms	120 forms @ $0.15/form	$18
Task VI: Evaluate Survey Results		
Supervisory time	1 manday	1 manday
Clerical time	1 manday	1 manday

Task/Category	Estimated Cost Unit	Total
Estimated Total Costs (Task II Performed By Agency)		
First set of surveys:		
Supervisory time		4 mandays
Clerical time		17 mandays
Services and materials		$192
Each additional set of surveys:		
Supervisory time		3 mandays
Clerical time		15 mandays
Services and materials		$172
Estimated Total Costs (Task II Performed By Professional Survey Firm)		
First set of surveys:		
Supervisory time		3 mandays
Clerical time		9 mandays
Services and materials		$612
Each additional set of surveys:		
Supervisory time		3 mandays
Clerical time		9 mandays
Services and materials		$592

Scentometer Measurement Costs

The following estimates represent the use of a scentometer in routine surveillance for one day.

Task/Category	Estimated Cost Unit	Total
Task I: Prepare for Field Use		
Purchase of Barnebey-Cheney Model I-3 Scentometer (first use only)	$85	$85
Task II: Conduct Field Measurements		
Technician time:		
Scentometer operator	1 manday	1 manday
Driver	1 manday	1 manday
Agency vehicle use	200 miles @ $0.12/ mile	$24

Task/Category	Estimated Cost Unit	Total
Task III: Evaluate Measurements		
Supervisory time	0.5 manday	0.5 manday
Estimated Total Costs		
First use:		
Supervisory time		0.5 manday
Technician time		2 mandays
Materials		$109
Each additional use:		
Supervisory time		0.5 manday
Technician time		2 mandays
Materials		$24

Odor Judgment Panel Costs

The estimates provided below include the costs of selecting, training, and using twelve odor judgment panelists for source verification in one test area.

Task/Category	Estimated Cost Unit	Total
Task I: Preliminary Activities		
Supervisory time	1 manday	1 manday
Agency vehicle use	100 miles @ $0.12/ mile	$12
Task II: Screen Candidates		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of odor free room	$25/day	$25
Purchase of Barnebey-Cheney Model ABB Activated Carbon Room Purifier Unit (first use only)	$480	$480
Purchase of food extracts, mixing bottles, and cups	$10	$10
Payments to candidates (successful candidates only)	12 candidates @ $20/ candidate	$240

Task/Category	Estimated Cost	
	Unit	Total
Task III: Train Panelists		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of odor free room	$25/day	$25
Purchase of odorant, solvents, mixing bottles, plastic bottles	$50	$50
Payments to panelists	12 panelists @ $20/ panelist	$240
Task IV: Perform Field Evaluations		
Supervisory time	1 manday	1 manday
Technician time	1 manday	1 manday
Rental of station wagons	2 station wagons @ $17/day plus $0.17/mile (200 miles)	$68
Reproduction of rating forms	80 forms @ $0.05/ form	$4
Payments to panelists	12 panelists @ $20/ panelist	$240
Task V: Summarize Field Evaluations		
Supervisory time	1 manday	1 manday
Technician time	2 mandays	2 mandays
Estimated Panel Preparation Costs		
First panel:		
Supervisory time		3 mandays
Technician time		2 mandays
Services and materials		$1,082
Each additional panel:		
Supervisory time		3 mandays
Technician time		2 mandays
Services and materials		$602
Estimated (Daily) Field Evaluation Costs		
Supervisory time		2 mandays
Technician time		3 mandays
Services and materials		$312

SUGGESTED REFERENCES

Census Tract Data

U. S. Bureau of the Census. U. S. Census of Population and Housing: 1960. Census Tracts. Washington, D.C.: U. S. Government Printing Office, 1962.

Census tract data for use by each local agency are recorded in one of a series of reports under the above title. The Bureau of the Census should be contacted to determine the report number for the agency's jurisdiction. Census tract data for 1970 should be available in similar form in early 1972. Census tract maps are included with these reports.

Odor Judgment Panel Information

Turk, Amos, and Wittes, Janet "The Selection of Judges for Odor Discrimination Panels," Correlation of Subjective-Objective Methods in the Study of Odors and Taste. Special Technical Publication No. 440, American Society for Testing and Materials, 1968.

This comprehensive discussion of the use and analysis of screening tests was co-authored by Amos Turk, the originator of the odor judgment panel technique.

Scentometer Information

Huey, Norman A., Broering, Louis C., Jutze, George A., and Gurber, Charles W. "Objective Odor Pollution Control Investigations," Journal of the Air Pollution Control Association, X, No. 6 (December, 1960), 441-446.

This article, by the developers of the scentometer, provides the most comprehensive description available of the physical characteristics of the device and the principles of operation.

Statistical Tables

Mathematical Tables From Handbook of Chemistry and Physics. Cleveland, Ohio: Chemical Rubber Publishing Company, any edition.

Tables of square roots, needed for Odor Problem Identification (see page 24), and other values are included in this mathematical section of the widely used handbook.

The Rand Corporation. A Million Random Digits With 100,000 Normal Deviates. Glencoe, Illinois: The Free Press, 1955.

This book contains an extensive listing of 5-digit random numbers. These numbers can be used to select an unbiased sample of test area and control area telephone numbers from a street address telephone directory (see page 7, "Obtaining a Sample"). The first two digits of any of the 5-digit numbers would provide a starting point for areas having zero to 99 listed telephones. Similarly, the first three digits would provide a starting point for areas having zero to 999 listed telephones.